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PIV Measurements of Slug Flow in a Square Microchannel BRADFORD BRUNO, JASON ROSEN, Union College, Mechanical Engineering Department — Many "lab on a chip" flows contain packets of one fluid, e.g. water, surrounded by a non-mixing fluid, e.g. oil, flowing through microchannels. This flow regime is referred to as slug flow. Issues of current importance include determining the magnitudes of wall shear (drag) forces and the mixing characteristics associated with slug flows. Water in oil slug flow was studied by Micro-PIV in a square cross section micro-channel. The slug flows have $Re_D \cong 10$, (D = channel hydraulic diameter), and Ca $\cong 1.4 \times 10^{-4}$. Aspect ratios, A, (A = L/D, where L = slug length) from 1.5 to 3.25 were studied. Measurements of the slug internal flow fields are presented. These show that the flows are qualitatively well described by solutions to the Biharmonic equation. Entry length like regions (and similar "exit regions") are observed at the leading (trailing) edge of the slugs over which the velocity profile varies from nearly uniform to a fully developed parabolic profile. These regions affect the wall shear (viscous drag) developed by slugs. In a co-ordinate frame traveling with the slug two counter rotating regions which resemble "tank tracks" rolling along the channel walls become apparent. Regions of high shear, which have important implications for mixing, are observed near the leading and trailing edge of the slug where these "rolling tracks" come together or separate.

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